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# NASA Procedural Requirements

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## Subject: Systems Engineering Procedural Requirements

**Responsible Office: Office of the Chief Engineer**

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### Appendix C. Practices for Common Technical Processes

a. This appendix contains best typical practices as extracted from industry and national and international standards and as found within the Agency. The practices may be used by Centers in preparing directives, policies, rules, work instructions, and other documents implementing SE processes. The practices of this appendix may also be used in the future assessments of those plans and processes to provide feedback to the OCE and Centers on the strengths and weaknesses in the Center's implementation of this SE NPR. These practices can be expanded and updated as necessary.

b. Each process is described in terms of purpose, inputs, outputs, and activities. Notes are provided to further explain a process and to help understand the best practices included. A descriptive figure is also provided for each process to illustrate notional relationships between activities within a process and the sources of inputs and destinations of outputs. Figures in this appendix are not intended to include all possible inputs, outputs, or intermediate work products.<sup>[2]</sup>

#### c. System Design Processes

a. There are four system design processes applied to each product-based WBS model from the top to the bottom of the system structure: (1) Stakeholder Expectation Definition, (2) Technical Requirements Definition, (3) Logical Decomposition, and (4) Design Solution Definition. (See Figure 3-2.)

b. During the application of these four processes to a WBS model it is expected that there will be a need to apply activities from other processes yet to be completed in this set of processes and to repeat process activities already performed in order to arrive at an acceptable set of requirements and solutions. There will also be a need to interact with the technical management processes to aid in identifying and resolving issues and making decisions between alternatives.

c. For software products, the technical team should refer to NPR 7150.2 software design requirements. The technical team should also ensure that the process implementations comply with NPR 7150.2 software product realization requirements for software aspects of the system.

### C.1.1 Stakeholder Expectations Definition Process

#### C.1.1.1 Purpose

#### C.1.1.2 Inputs and Sources:

- a. Customer expectations (from users and program and/or project)
- b. Other stakeholder expectations (from project and/or other interested parties of the WBS model products - recursive loop).
- c. [Customer flow-down requirements from previous level WBS model products \(from Design Solution Definition\)](#)

## Process - recursive loop - and Requirements Management and Interface Management Processes)

### **C.1.1.3 Outputs and Destinations:**

- a. Set of validated stakeholder expectations, including interface requirements (to Technical Requirements ;Definition, Requirements Management, and Interface Management Processes).
- b. Baseline operational concepts (to Technical Requirements Definition Process and Configuration Management Processes).
- c. Baseline set of enabling product support strategies (to Technical Requirements Definition Process and Configuration Management Processes).
- d. Measures of Effectiveness (MOEs) (to Technical Requirements Definition Process and Technical Data Management Process).

### **C.1.1.4 Activities**

For the WBS model in the system structure, the following activities are typically performed:

- a. Establish a list that identifies customers and other stakeholders that have an interest in the system and its products.
- b. Elicit customer and other stakeholder expectations (needs, wants, desires, capabilities, external interfaces, and constraints) from the identified stakeholders.
- c. Establish operational concepts and support strategies based on stakeholder expected use of the system products over the system's life.
- d. Define stakeholder expectations in acceptable statements that are complete sentences and have the following characteristics: (1) individually clear, correct, and feasible to satisfy; not stated as to how it is to be satisfied; implementable; only one interpretation of meaning; one actor-verb-object expectation; and can be validated at the level of the system structure at which it is stated; and (2) in pairs or as a set there is an absence of redundancy, consistency with respect to terms used, not in conflict with one another, and do not contain stakeholder expectations of questionable utility or which have an unacceptable risk of satisfaction.
- e. Analyze stakeholder expectation statements to establish a set of measures (measures of effectiveness) by which overall system or product effectiveness will be judged and customer satisfaction will be determined.
- f. Validate that the resulting set of stakeholder expectation statements are upward and downward traceable to reflect the elicited set of stakeholder expectations and that any anomalies identified are resolved.
- g. Obtain commitments from customer and other stakeholders that the resultant set of stakeholder expectation statements is acceptable.
- h. Baseline the agreed to set of stakeholder expectation statements.

### **C.1.1.5 Process Flow Diagram**

- a. A typical process flow diagram for the stakeholder expectations definition process is provided in Figure C-1 with inputs and their sources and the outputs and their destinations. The activities of the stakeholder expectations definition process are truncated to indicate the action and object of the action.
- b. The customer flow-down requirements from the design solution definition process are applicable at levels of the system structure below the top level. The other stakeholder expectations are applicable at each level of the system structure to reflect the local management policies, applicable standards and regulations, and enabling product support needs for the lower level WBS model products.

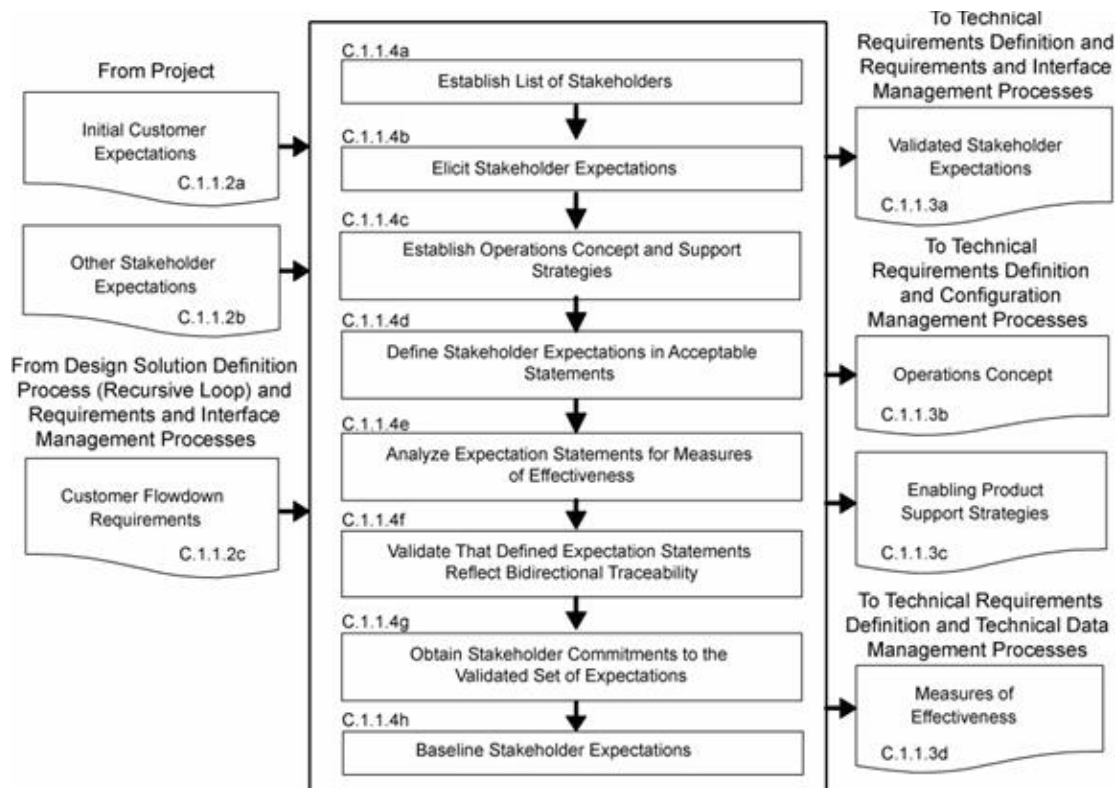


Figure C-1 - Stakeholder Expectation Definition Process

## C.1.2 Technical Requirements Definition Process

### C.1.2.1 Purpose

#### C.1.2.2 Inputs and Sources:

- Baselined set of stakeholder expectations, including interface requirements (from Stakeholder Expectations Definition and Configuration Management Processes).
- Baselined Concept of Operation (from Stakeholder Expectations Definition and Configuration Management Processes).
- Baselined Enabling Product Support Strategies (from Stakeholder Expectations Definition and Configuration Management Processes).
- Measures of Effectiveness (from Stakeholder Expectations Definition and Technical Data Management Processes).

#### C.1.2.3 Outputs and Destinations:

- Set of validated technical requirements that represents a reasonably complete description of the problem to be solved, including interface requirements (to Logical Decomposition and Requirements and Interface Management Processes).
- Sets of MOPs that when met will satisfy the MOE to which a set is related (to Logical Decomposition and Technical Data Management Processes).
- A set of critical technical performance measures (TPMs) that if not met will put the project in cost, schedule or performance risk (to Technical Assessment Process).

### C.1.2.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- Analyze the scope of the technical problem to be solved to identify and resolve the design boundary that identifies: (1) which system functions are under design control and which are not; (2) expected interaction among system functions (data flows, human responses, and behaviors); (3) external physical and functional interfaces

(mechanical, electrical, thermal, data, procedural) with other systems; (4) required capacities of system products; (5) timing of events, states, modes, and functions related to operational scenarios; and (6) emerging or maturing technologies necessary to make requirements.

b. Define constraints affecting the design of the system or products or how the system or products will be able to be used.

c. Define functional and behavioral expectations for the system or product in acceptable technical terms for the range of anticipated uses of system products as identified in the concept of operations. This permits separation of defined stakeholder expectation functions and behaviors that belong to a lower level in the system structure and to allocate them to the appropriate level.

d. Define the performance requirements associated with each defined functional and behavioral expectation.

e. Define technical requirements in acceptable "shall" statements that are complete sentences with a single "shall" per numbered statement and have the following characteristics: (1) individually clear, correct, and feasible to satisfy; not stated as to how it is to be satisfied; implementable; only one interpretation of meaning; one actor-verb-object requirement; and can be validated at the level of the system structure at which it is stated; and (2) in pairs or as a set there is an absence of redundancy, consistent with respect to terms used, not in conflict with one another, and form a set of "design-to" requirements.

f. Validate that the resulting technical requirement statements (1) have bidirectional traceability to the baselined stakeholder expectations; (2) were formed using valid assumptions; and (3) are essential to and consistent with designing and realizing the appropriate product solution form that will satisfy the applicable product-line life-cycle phase exit criteria.

g. Define MOPs for each identified measure of effectiveness (MOE) that cannot be directly used as a design-to technical requirement.

h. Define appropriate TPMs by which technical progress will be assessed.

i. Establish the technical requirements baseline.

### C.1.2.5 Process Flow Diagram

A typical process flow diagram for the technical requirements definition process is provided in Figure C-2 with inputs and their sources and the outputs and their destinations. The activities of the technical requirements definition process are truncated to indicate the action and object of the action.

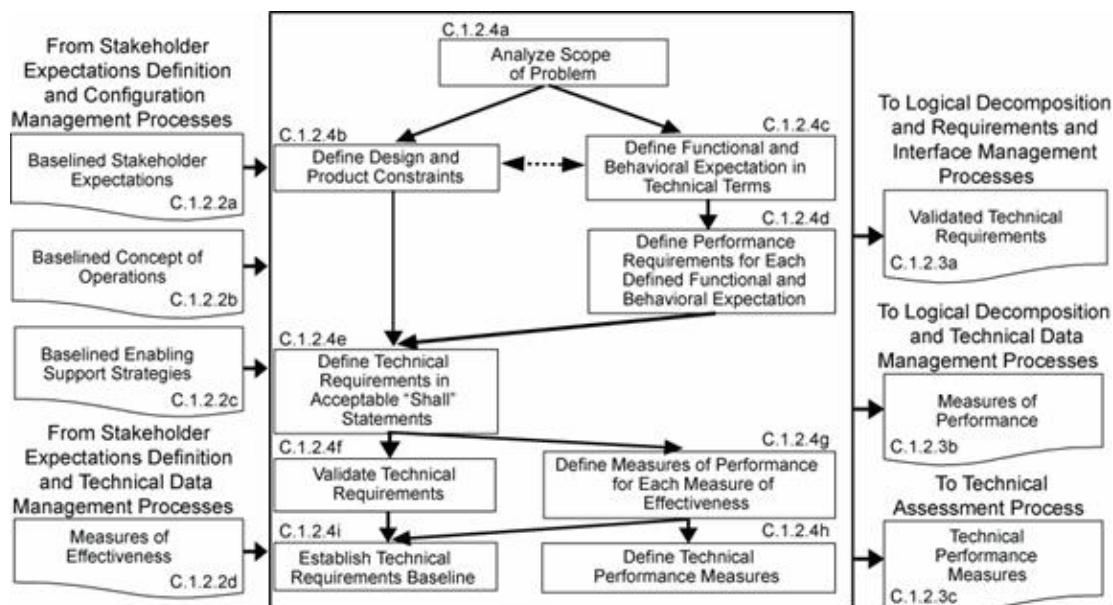


Figure C-2 - Technical Requirements Definition Process

## C.1.3 Logical Decomposition Process

### C.1.3.1 Purpose

### C.1.3.2 Inputs and Sources:

- a. The baseline set of validated technical requirements, including interface requirements (from Technical Requirements Definition and Configuration Management Processes).
- b. The defined MOPs (from Technical Requirements Definition and Technical Data Management Processes).

### **C.1.3.3 Outputs and Destinations:**

- a. Set of validated derived technical requirements, including interface requirements (to Design Solution Definition and Requirements and Interface Management Processes).
- b. The set of logical decomposition models (to Design Solution Definition and Configuration Management Processes).
- c. Logical decomposition work products (to Technical Data Management Processes).

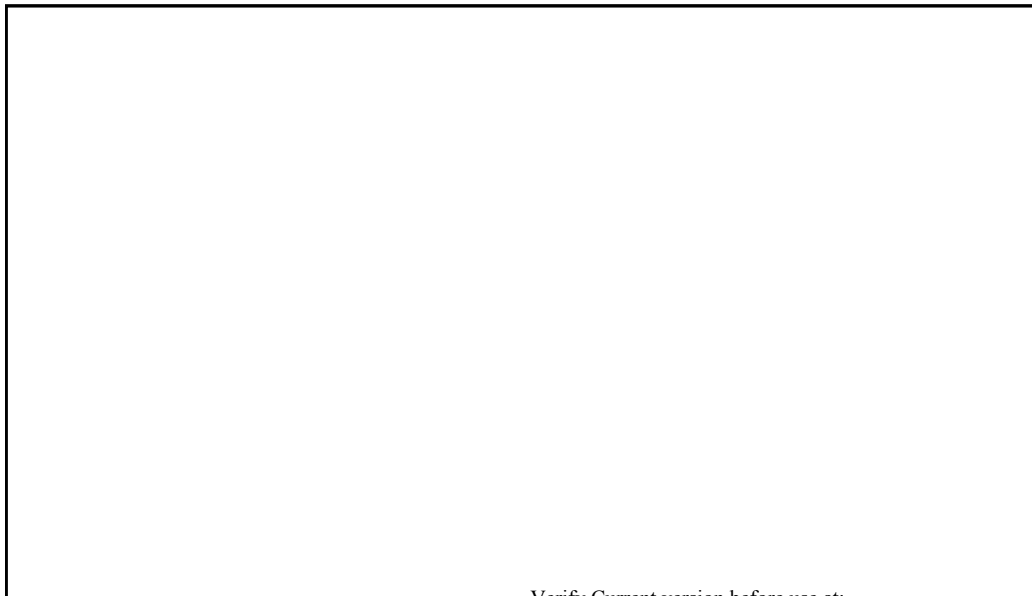
### **C.1.3.4 Activities:**

For the WBS model in the system structure, the following activities are typically performed:

- a. Define one or more logical decomposition models based on the defined technical requirements to gain a more detailed understanding and definition of the design problem to be solved.
- b. Allocate the technical requirements to the logical decomposition models to form a set of derived technical requirement statements that have the following characteristics:
  - 1. Describe functional and performance, service and attribute, time, and data flow requirements, etc., as appropriate for the selected set of logical decomposition models.
  - 2. Individually are complete sentences and are clear, correct, and feasible to satisfy; not stated as to how to be satisfied; implementable; only have one interpretation of meaning, one actor-verb-object expectation; and can be validated at the level of the system structure at which it is stated.
  - 3. In pairs or as a set, have an absence of redundancy, are adequately related with respect to terms used, and are not in conflict with one another.
  - 4. Form a set of detailed "design-to" requirements.
- c. Resolve derived technical requirement conflicts.
- d. Validate that the resulting set of derived technical requirements have: (1) bidirectional traceability with the set of validated technical requirements and (2) assumptions and decision rationale consistent with the source set of technical requirements.
- e. Establish the derived technical requirements baseline.

### **C.1.3.5 Process Flow Diagram**

A typical process flow diagram for logical decomposition is provided in Figure C-3 with inputs and their sources and the outputs and their destinations. The activities of the logical decomposition process are truncated to indicate the action and object of the action.



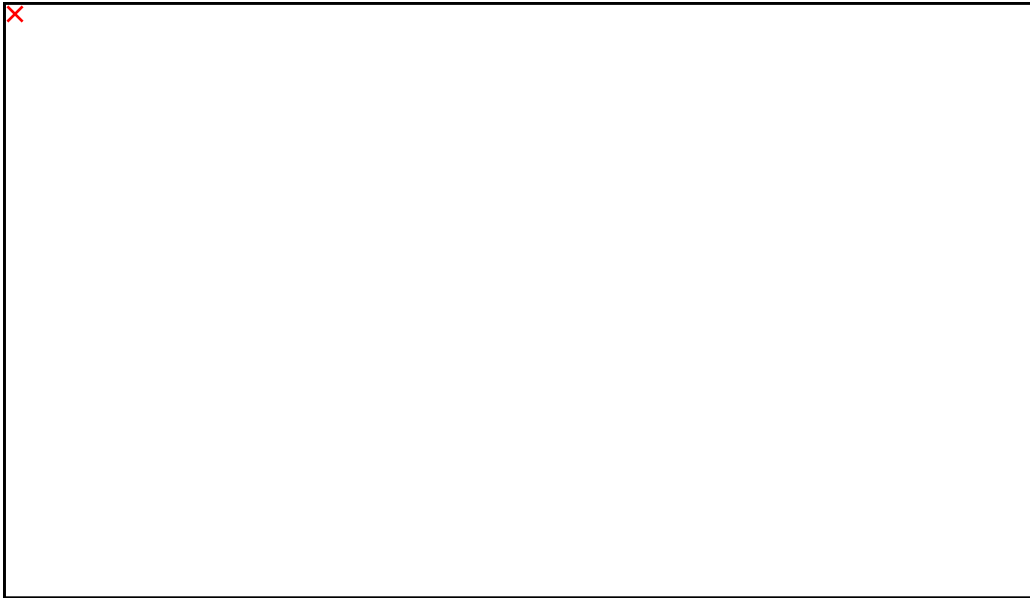


Figure C-3 - Logical Decomposition Process

## C.1.4 Design Solution Definition Process

### C.1.4.1 Purpose

#### C.1.4.2 Inputs and Sources:

- a. A baselined set of logical decomposition models (from Logical Decomposition and Configuration Management Processes).
- b. [A baseline set of derived technical requirements including interface requirements \(from Logical Decomposition and Configuration Management Processes\).](#)

#### C.1.4.3 Outputs and Destinations:

The specified requirements that describe the system design solution definition for the products of the WBS model under development include:

- a. A WBS model design solution definition set of requirements for the system (see WBS definition in Appendix A), including specification configuration documentation and external interface specification (to Requirements and Interface Management Process).
- b. [A baseline set of "make-to," "buy-to," "reuse-to," or set of "assemble and integrate-to" specified requirements \(specifications and configuration documents\) for the desired end product of the WBS model, including interface specifications \(to Requirements and Interface Management Process\).](#)
- c. [The initial specifications for WBS model subsystems for flow down to the next applicable lower level WBS models, including interface specifications \(to Stakeholder Expectations Definition, and Requirements and Interface Management Processes\).](#)
- d. The requirements for enabling products that will be needed to provide life-cycle support to the end products, including interface requirements (to Stakeholder Expectations Definition Process for development of enabling products or to Product Implementation Process for acquisition of existing enabling products, and Requirements and Interface Management Processes).
- e. [A product verification plan that will be used to demonstrate that the product generated from the design solution definition conforms to the design solution definition specified requirements \(to Product Verification Process\).](#)
- f. [A product validation plan that will be used to demonstrate that the product generated from the design solution definition conforms to its set of stakeholder expectations \(to Product Validation Process\).](#)
- g. Baseline operate-to and logistics procedures (to Technical Data Management Process).

### C.1.4.4 Activities



For the WBS model in the system structure, the following activities are typically performed:

- a. Define alternative solutions for the system end product being developed or improved that are consistent with derived technical requirements and non-allocated technical requirements, if any.
- b. Analyze each alternative solution against defined criteria such as: satisfaction of external interface requirements; technology requirements; off-the-shelf availability of products; physical failure modes, effects and criticality; life-cycle cost and support considerations; capacity to evolve; make vs. buy; standardization of products; integration concerns; and context of use issues of operators considering tasks, location, workplace equipment, and ambient conditions.
- c. Select the best solution alternative based on the analysis results of each alternative solution and technical decision analysis recommendations.
- d. Generate the full design description of the selected alternative solution in a form appropriate to the product-line life-cycle phase, location of the WBS model in the system structure, and phase exit criteria to include: (1) system specification and external interface specifications; (2) end product specifications, configuration description documents, and interface specifications; (3) end product subsystem initial specifications, if subsystems are required; (4) requirements for associated supporting enabling products; (5) end product verification plan; (6) end product validation plan; and (7) applicable logistics and operate-to procedures.
- e. Verify that the design solution definition: (1) is realizable within constraints imposed on the technical effort; (2) has specified requirements that are stated in acceptable statements and have bidirectional traceability with the derived technical requirements, technical requirements and stakeholder expectations; (3) has decisions and assumptions made in forming the solution consistent with its set of derived technical requirements, separately allocated technical requirements, and identified system product and service constraints.
- f. Baseline the design solution definition specified requirements including the specifications and configuration descriptions.
- g. Initiate development or acquisition of the life cycle supporting enabling products needed, as applicable, for research, development, fabrication, integration, test, deployment, operations, sustainment, and disposal.
- h. Initiate development of the system products of the next lower level WBS model, if any.

#### **C.1.4.5 Process Flow Diagram**

A typical process flow diagram for design solution definition is provided in Figure C-4 with inputs and their sources and the outputs and their destinations. The activities of the design solution definition process are truncated to indicate the action and object of the action.

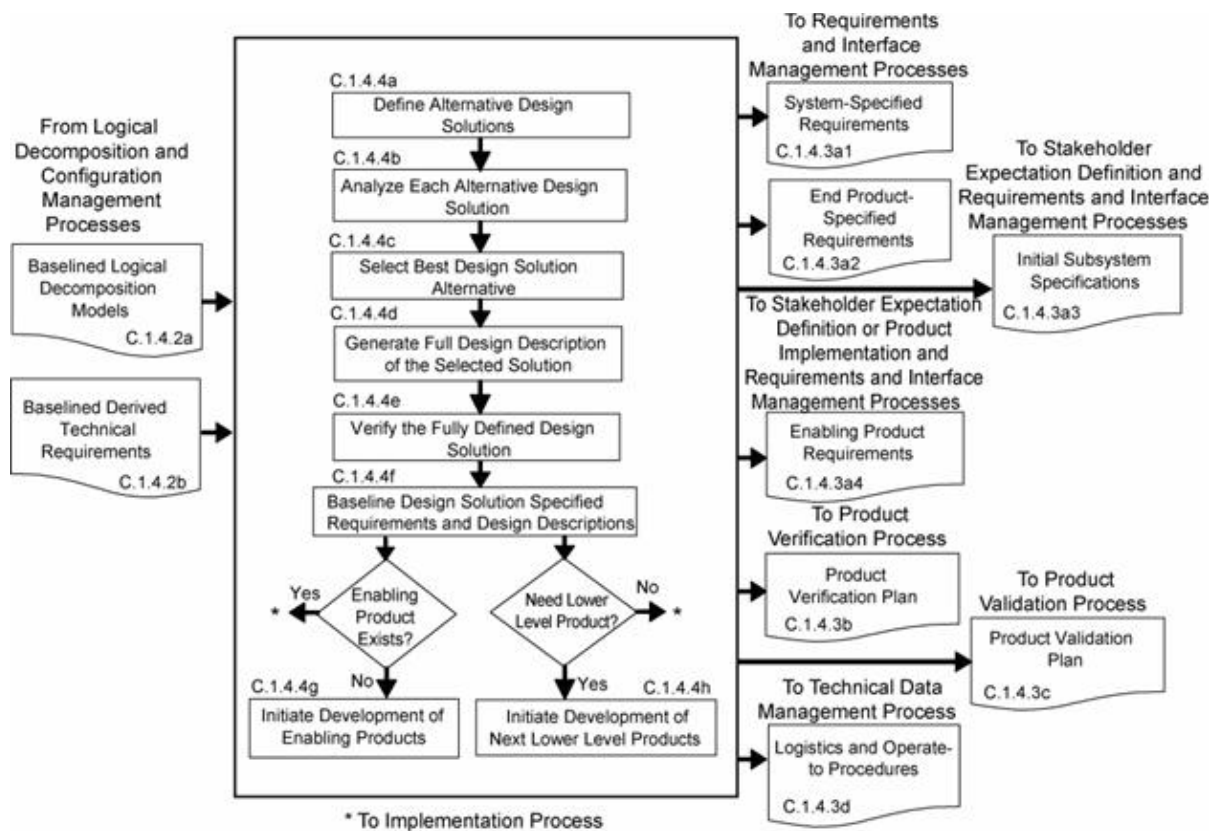


Figure C-4 - Design Solution Definition Process

## C.2 Product Realization Processes

There are five product realization processes. Four of the product realization processes are applied to each end product of a WBS model from the bottom to the top of the system structure: (1) either product implementation or product integration, (2) product verification, (3) product validation, and (4) product transition. (See Figure 3-2) The form of the end product realized will be dependent on the applicable product-line life-cycle phase, location within the system structure of the WBS model containing the end product, and the exit criteria of the phase. Typical early phase products are in the form of reports, models, simulations, mockups, prototypes, or demonstrators. Later phase product forms include the final mission products, including payloads and experiment equipment. For software products, the technical team should refer to NPR 7150.2 for software product realization requirements. The technical team should also ensure that the process implementations comply with NPR 7150.2, NASA Software Engineering Requirements for software aspects of the system. The product realization process descriptions that follow assume that each lowest level product goes through the sequencing shown in Figure C-5a. Exceptions will need to be planned according to what has and has not been already performed.

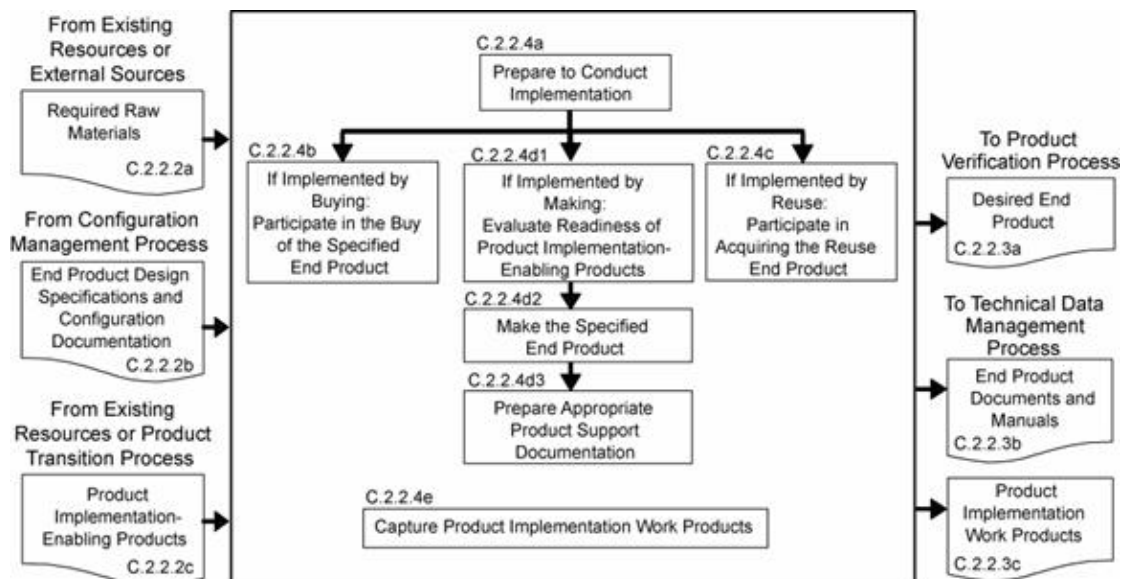




Figure C-5a -Sequencing of Design Realization Processes

## C.2.1Product Implementation Process

### C.2.1.1 Purpose

#### C.2.1.2 Inputs and Sources:

- a. Raw materials needed to make the end product (from existing resources or external sources).
- b. End product design solution definition specified requirements (specifications) and configuration documentation for the end product of the applicable WBS model, including interface specifications, in the form appropriate to satisfying the product-line life-cycle phase exit criteria (from Configuration Management Process).
- c. Product implementation enabling products (from existing resources or Product Transition Process for enabling product realization).

#### C.2.1.3 Outputs and Destinations:

- a. Made, bought, or reused end product in the form appropriate to the product-line life-cycle phase and to satisfy exit criteria (to Product Verification Process).
- b. Documentation and manuals in a form appropriate for satisfying the life-cycle phase exit criteria, including "as-built" product descriptions and "operate-to" and maintenance manuals (to Technical Data Management Process).
- c. Product implementation work products needed to provide reports, records, and non-deliverable outcomes of process activities (to Technical Data Management Process).

### C.2.1.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- a. Prepare to conduct product implementation to include (1) preparing a product implementation strategy and detailed planning and procedures; and (2) determining whether the product configuration documentation is adequately complete to conduct the type of product implementation as applicable for the product-line life-cycle phase, location of the product in the system structure, and phase exit criteria.
- b. If the strategy is for buying an existing product, participate in the buy of the product including (1) review of the technical information made available by vendors; (2) assisting in the preparation of requests for acquiring the product from a vendor; (3) assisting in the inspection of the delivered product and the accompanying documentation; (4) determination of whether the vendor conducted product validation or if it will need to be done by a project technical team and (5) determination of the availability of enabling products to provide test, operations, and maintenance support and disposal services for the product.
- c. If the strategy is to reuse a product that exists in the Government inventory, participate in the acquiring of the reuse product including: (1) review of the technical information made available for the specified product to be reused; (2) determination of supporting documentation and user manuals availability; (3) determination of availability of enabling products to provide test, operations, and maintenance support and disposal services for the product; (5) assisting in the requests for acquiring the product from Government sources; and (4) assisting in the inspection of the delivered product and the accompanying documentation.
- d. If the strategy is to make the product,
  1. Evaluate the readiness of the product implementation enabling products to conduct the making of the product.
  2. Make the specified product in accordance with the specified requirements, configuration documentation, and applicable standards.
  3. Prepare appropriate product support documentation such as integration constraints and/or special procedures for performing product verification and product validation.
- e. Capture work products and related information generated while performing the product implementation process activities.

### C.2.1.5 Process Flow Diagram

C.2.1.5.1 Atypical process flow diagram for product implementation is provided in Figure C-5b with inputs and their

sources and the outputs and their destinations. The activities of the product implementation process are truncated to indicate the action and object of the action.

C.2.1.5.2 The path that products from the three sources in Figure C-5b take with respect to product verification, product validation, and product transition vary based on:

- Whether the products bought have been verified and/or validated by the vendor.
- Whether reuse products that come from within the organization have been verified and/or validated.
- Whether the customer for the product desires to do the product validation or have the developer perform the product validation.

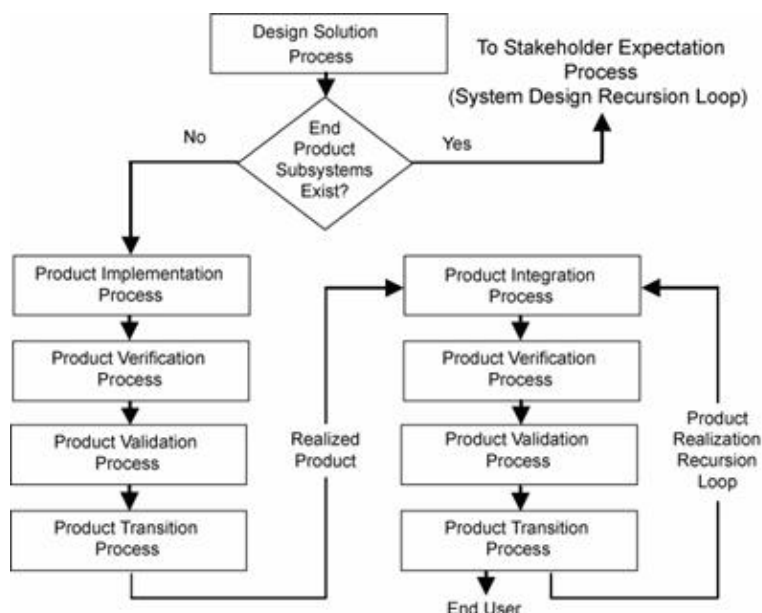


Figure C-5b - Product Implementation Process

## C.2.2 Product Integration Process

### C.2.2.1 Purpose

### C.2.2.2 Inputs and Sources:

- Lower-level products to be assembled and integrated (from Product Transition Process).
- End product design definition specified requirements (specifications) and configuration documentation for the applicable WBS model, including interface specifications, in the form appropriate to satisfying the product-line life-cycle phase exit criteria (from Configuration Management Process).
- Product integration enabling products (from existing resources or Product Transition Process for enabling product realization).

### C.2.2.3 Outputs and Destinations:

- Integrated product(s) in the form appropriate to the product-line life-cycle phase and to satisfy phase exit criteria (to Product Verification Process).
- Documentation and manuals in a form appropriate for satisfying the life-cycle phase exit criteria, including "as-integrated" product descriptions and "operate-to" and maintenance manuals (to Technical Data Management Process).
- Product integration work products needed to provide reports, records, and non-deliverable outcomes of process activities (to Technical Data Management Process).

### C.2.2.4 Activities

For the WBS model in the system structure, the following activities are typically performed

- Prepare to conduct product integration to include (1) preparing a product integration strategy, detailed planning

for the integration, and integration sequences and procedures; and (2) determining whether the product configuration documentation is adequately complete to conduct the type of product integration applicable for the product-line life-cycle phase, location of the product in the system structure, and management phase exit criteria.

b. Obtain lower level products required to assemble and integrate into the desired product.

c. Confirm that the received products that are to be assembled and integrated have been validated to demonstrate that the individual products satisfy the agreed to set of stakeholder expectations, including interfaces requirements.

d. Prepare the integration environment in which assembly and integration will take place to include evaluating the readiness of the product integration enabling products and the assigned workforce.

e. Assemble and integrate the received products into the desired end product in accordance with the specified requirements, configuration documentation, interface requirements, applicable standards, and integration sequencing and procedures.

f. Prepare appropriate product support documentation such as special procedures for performing product verification and product validation.

g. Capture work products and related information generated while performing the product integration process activities.

### C.2.2.5 Process Flow Diagram

A typical process flow diagram for product integration is provided in Figure C-6 with inputs and their sources and the outputs and their destinations. The activities of the product integration process are truncated to indicate the action and object of the action.

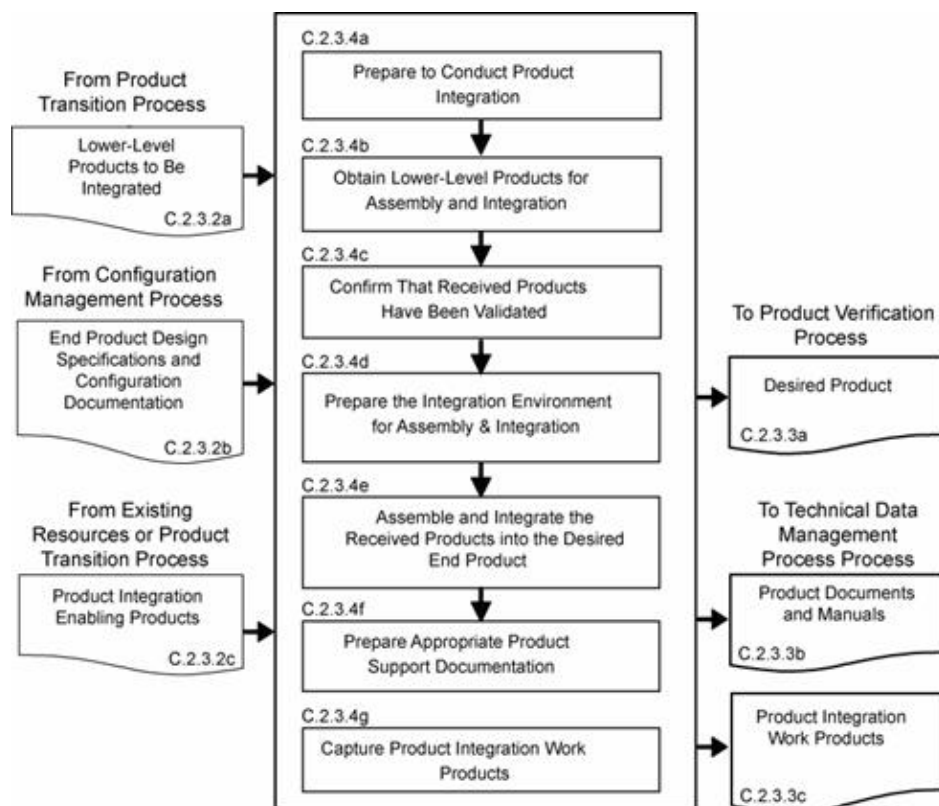


Figure C-6 - Product Integration Process

## C.2.3 Product Verification Process

### C.2.3.1 Purpose

### C.2.3.2 Inputs and Sources:

a. End product to be verified (from Product Implementation Process or Product Integration Process).

b. End product specification and configuration baselines, including interface specifications, to which the product

being verified was generated (from Technical Data Management Process).

- c. Product verification plan (from Design Solution Definition Process and Technical Planning Process)
- d. Product verification enabling products (from existing resources or Product Transition Process for enabling product realization).

### **C.2.3.3 Outputs and Destinations:**

- a. A verified end product (to Product Validation Process).
- b. Product verification results (to Technical Assessment Process).
- c. Completed verification report to include for each specified requirement: (1) the source paragraph references from the baseline documents for derived technical requirements, technical requirements and stakeholder expectations; (2) bidirectional traceability among these sources; (3) verification type(s) to be used in performing verification of the specified requirement; (4) reference to any special equipment, conditions, or procedures for performing the verification; (5) results of verification conducted; (6) variations, anomalies, or out-of-compliance results; (7) corrective actions taken; and (8) results of corrective actions (to Technical Data Management Process).
- d. Product verification work products needed to provide reports, records, and non-deliverable outcomes of process activities (to Technical Data Management Process).

### **C.2.3.4 Activities**

For the WBS model in the system structure, the following activities are typically performed:

- a. Prepare to conduct product verification to include as applicable to the product-line life-cycle phase and WBS model location in the system structure: (1) reviewing the product verification plan for specific procedures, constraints, conditions under which verification will take place, pre and post verification actions, and criteria for determining the success or failure of verification methods and procedures; (2) arranging the needed product verification enabling products and support resources; (3) obtaining the end product to be verified; (4) obtaining the specification and configuration baseline against which the verification is to be made; and (5) establishing and checking the verification environment to ensure readiness for performing the verification.
- b. Perform the product verification in accordance with the product verification plan and defined procedures to collect data on each specified requirement with specific attention given to MOPs.
- c. Analyze the outcomes of the product verification to include identification of verification anomalies, establishing recommended corrective actions, and/or establishing conformance to each specified requirement under controlled conditions.
- d. Prepare a product verification report providing the evidence of product conformance with the applicable design solution definition specified requirements baseline to which the product was generated including bidirectional requirements traceability and corrective actions taken to correct anomalies of verification results.
- e. Capture the work products from the product verification.

### **C.2.3.5 Process Flow Diagram**

A typical process flow diagram for product verification is provided in Figure C-7 with inputs and their sources and the outputs and their destinations. The activities of the product verification process are truncated to indicate the action and object of the action.

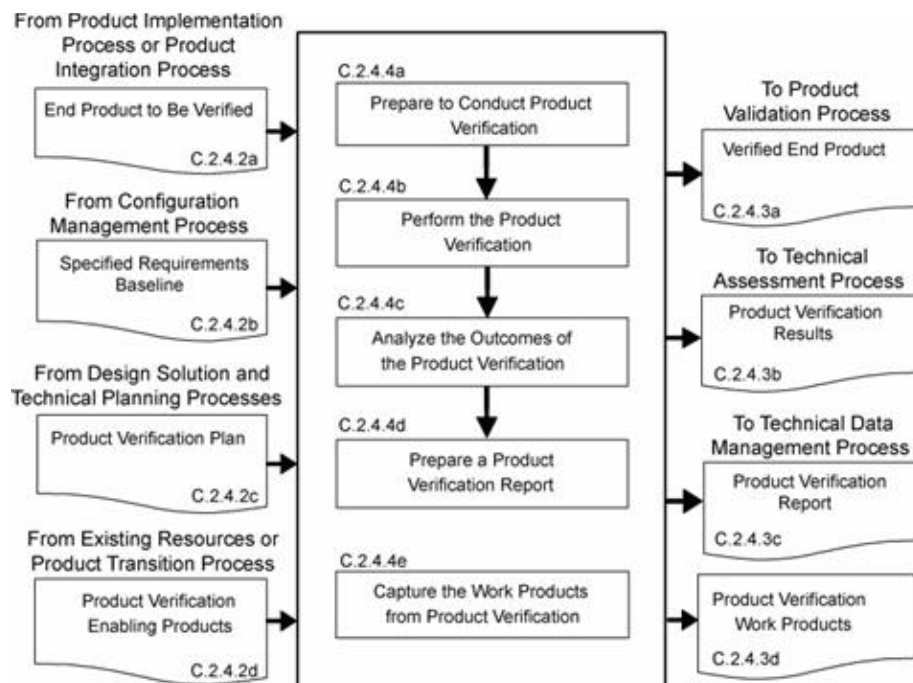


Figure C-7 - Product Verification Process

## C.2.4 Product Validation Process

### C.2.4.1 Purpose

### C.2.4.2 Inputs and Sources:

- End product to be validated (from Product Verification Process).
- [Stakeholder requirements baseline \(from Configuration Management Process\).](#)
- Product validation plan (from Design Solution Definition Process and Technical Planning Process)
- Product validation enabling products (from existing resources or Product Transition Process for enabling product realization).

### C.2.4.3 Outputs and Destinations:

- A validated end product (to Transition Process).
- Product validation results (to Technical Assessment Process).
- [Completed validation report to include for each stakeholder expectation or subset of stakeholder expectations involved with the validation, for example: \(1\) the source requirement paragraph reference from the stakeholder expectations baseline; \(2\) validation type\(s\) to be used in establishing compliance with selected set of stakeholder expectations and match with each source expectation referenced; \(3\) identification of any special equipment, conditions or procedures for performing the validation that includes referenced expectation; \(4\) results of validation conducted with respect to the referenced expectation; \(5\) deficiency findings \(variations, anomalies or out-of-compliance results\); \(6\) corrective actions taken; and \(7\) results of corrective actions \(to Technical Data Management Process\).](#)
- Product validation work products needed to provide reports, records, and non-deliverable outcomes of process activities (to Technical Data Management Process).

### C.2.4.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- [Prepare to conduct product validation to include as applicable to the product-line life-cycle phase and product location in the system structure: \(1\) reviewing the product validation plan for specific procedures, constraints, conditions under which validation will take place, pre and post validation actions, and criteria for determining the success or failure of validation methods and procedures; \(2\) arranging the needed product validation enabling](#)



products and support resources; (3) obtaining the end product to be validated; (4) obtaining the stakeholder expectations baseline against which the validation is to be made; and (5) establishing and checking out the validation environment to ensure readiness for performing the validation.

- b. Perform the product validation in accordance with the product validation plan and defined procedures to collect data on performance of the product against stakeholder expectations with specific attention given to MOEs.
- c. Analyze the outcomes of the product validation to include identification of validation anomalies, establishing recommended corrective actions, and/or establishing conformance to stakeholder expectations under operational conditions (actual, analyzed or simulated).
- d. A product validation report providing the evidence of product conformance with the stakeholder expectations baseline including corrective actions taken to correct anomalies of validation results
- e. Capture the work products from the product validation.

### C.2.4.5 Process Flow Diagram

A typical process flow diagram for product validation is provided in Figure C-8 with inputs and their sources and the outputs and their destinations. The activities of the product validation process are truncated to indicate the action and object of the action.

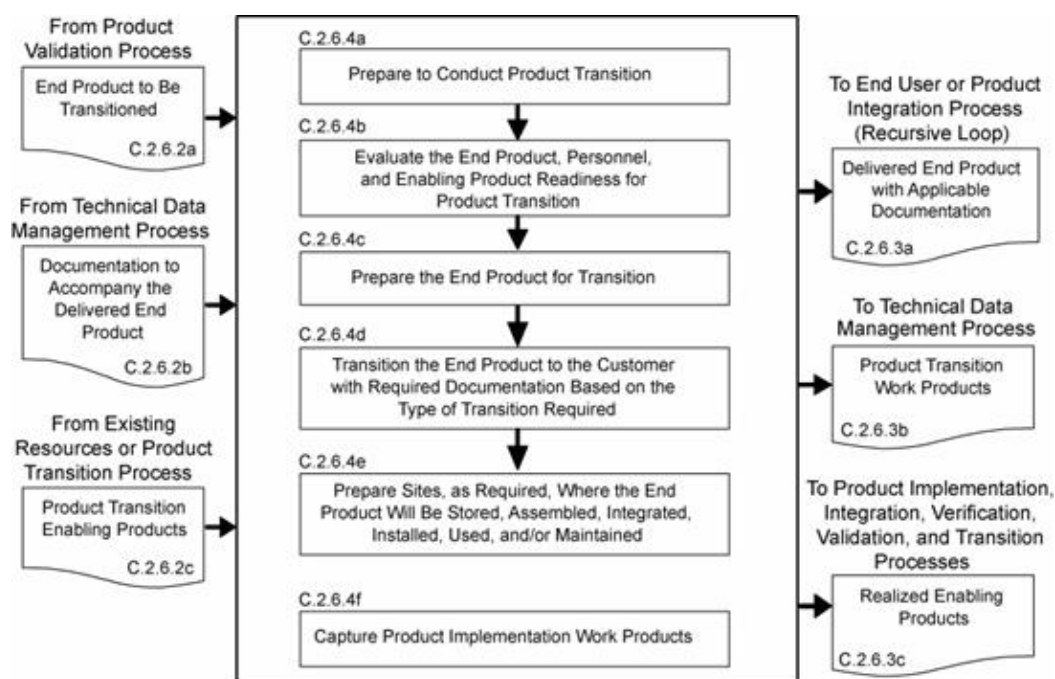


Figure C-8 - Product Validation Process

## C.2.5 Product Transition Process

### C.2.5.1 Purpose

### C.2.5.2 Inputs and Sources:

- a. End product or products to be transitioned (from Product Validation Process).
- b. Documentation including manuals, procedures and processes that are to accompany the end product (from Technical Data Management Process).
- c. Product transition enabling products to include packaging materials, containers, handling equipment, and storage, receiving and shipping facilities (from existing resources or Product Transition Process for enabling product realization).

### C.2.5.3 Outputs and Destinations:

- a. Delivered end product with applicable documentation including manuals, procedures and processes in a form consistent with the product-line life-cycle phase and location of the product in the system structure (to end user or Product Integration Process - recursive loop).

b. Product transition work products needed to provide reports, records, and non-deliverable outcomes of process activities (to Technical Data Management Process).

c. Realized enabling products from existing enabling products and services or from applying the common technical processes to develop and realize (to Product Implementation, Integration, Verification, Validation and Transition Processes, as appropriate)

### C.2.5.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

a. Prepare to conduct product transition to include (1) preparing a product implementation strategy to establish the type of product transition to be made (to the next higher level customer for product integration or to an end user); and (2) reviewing related end product stakeholder expectations and design solution definition specified requirements to identify special transition procedures and enabling product needs for the type of product transition, if any, for packaging, storage, handling, shipping/transporting, site preparation, installation, and/or sustainment.

b. Evaluate the end product, personnel, and enabling product readiness for product transition including: (1) availability and appropriateness of the documentation that will be packaged and shipped with the end product; (2) adequacy of procedures for conducting product transition; (3) availability and skills of personnel to conduct product transition; and (4) availability of packaging materials/containers, handling equipment, storage facilities, and shipping/transporter services.

c. Prepare the end product for transition to include the packaging and moving the product to the shipping/transporting location and any intermediate storage.

d. Transition the end product with required documentation to the customer based on the type of transition required, e.g., to the next higher level WBS model for product integration or to the end user.

e. Prepare sites, as required, where the end product will be stored, assembled, integrated, installed, used, and/or maintained, as appropriate for the life-cycle phase, position of the end product in the system structure, and customer agreement.

f. Capture work products from product transition process activities.

### C.2.5.5 Process Flow Diagram

A typical process flow diagram for product transition is provided in Figure C-9 with inputs and their sources and the outputs and their destinations. The activities of the product transition process are truncated to indicate the action and object of the action.

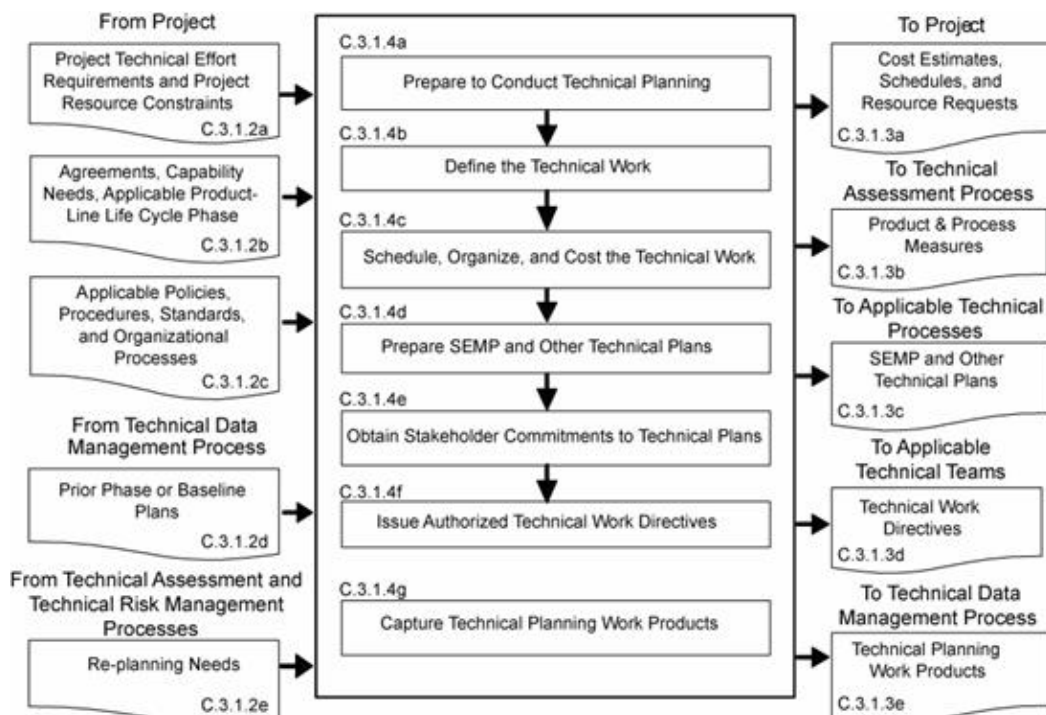


Figure C-9 - Product Transition Process

## C.3 Technical Management Processes

There are eight technical management processes-Planning, Requirements Management, Interface Management, Risk Management, Configuration Management, Technical Data Management, Assessment, and Decision Analysis. (See Figure 3-2.) These technical management processes are intended to supplement the management requirements defined in NPR 7120.5. NPR 7120.5 provides program and project managers with the technical activities that they are required to be cognizant of and are responsible for. On the other hand, the technical management process in this SE NPR: (1) provide the technical team their requirements for planning, monitoring and controlling the technical effort as well as the technical decision analysis requirements for performing tradeoff and effectiveness analyses to support decisionmaking throughout the technical effort; (2) focus on (a) completion of technical process planning (preparation of the SEMP and other technical plans), (b) technical progress assessment (using technical measures and conducting technical reviews to assess progress against the SEMP and defined technical requirements), and (c) control of product requirements, product interfaces, technical risks, configurations, technical data and include ensuring that common technical process implementations comply with NPR 7150.2 software product realization requirements for software aspects of the system. Documentation produced through each technical management process should be managed and dispositioned as Federal records.

### C.3.1 Technical Planning Process

#### C.3.1.1 Purpose

#### C.3.1.2 Inputs and Sources:

- a. Project technical effort requirements and project resource constraints (from the project).
- b. Agreements, capability needs and applicable product-line life-cycle phase(s) (from the project).
- c. Applicable policies, procedures, standards, and organizational processes (from the project).
- d. Prior product-line life-cycle phase or baseline plans (from Technical Data Management Process).
- e. Re-planning needs (from Technical Assessment and Technical Risk Management Processes).

#### C.3.1.3 Outputs and Destinations:

- a. Technical work cost estimates, schedules, and resource needs, e.g., funds, workforce, facilities, and equipment (to project).
- b. Product and process measures needed to assess progress of the technical effort and the effectiveness of processes (to Technical Assessment Process).
- c. The SEMP and other technical plans that support implementation of the technical effort (to all processes; applicable plans to Technical Processes).
- d. Technical work directives, e.g., work packages or task orders with work authorization (to applicable technical teams).
- e. Technical planning work products needed to provide reports, records, and nondeliverable outcomes of process activities (to Technical Data Management Process).

#### C.3.1.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- a. Prepare to conduct technical planning to include:
  - 1. Preparing or updating a planning strategy for each of the common technical processes of this SE NPR.
  - 2. Determining:
    - a) deliverable work products from technical efforts.
    - b) technical reporting requirements.
    - c) other technical information needs for reviews or satisfying product-line life-cycle management phase entry or exit criteria.
    - d) product and process measures to be used in measuring technical performance, cost, and schedule progress.

- e) key or critical technical events with entry and success criteria.
  - f) data management approach for data collection and storage and how measurement data will be analyzed, reported, and dispositioned as Federal records.
  - g) technical risks that need to be addressed in the planning effort.
  - h) tools and engineering methods to be employed in the technical effort.
  - i) approach to acquiring and maintaining the technical expertise needed (training and skills development plan).
- b. Define the technical work to be done to include associated technical, support, and management tasks needed to generate the deliverable products and satisfy entry and success criteria of key technical events and the applicable product-line life-cycle management phase.
- c. Schedule, organize, and cost the technical effort.
- d. Prepare the SEMP and other technical plans needed to support the technical effort and perform the technical processes.
- e. Obtain stakeholder commitments to the technical plans.
- f. Issue authorized technical work directives to implement the technical work.
- g. Capture work products from technical planning activities

### C.3.1.5 Process Flow Diagram

A typical process flow diagram for technical planning is provided in Figure C-10 with inputs and their sources and the outputs and their destinations. The activities of the technical planning process are truncated to indicate the action and object of the action.

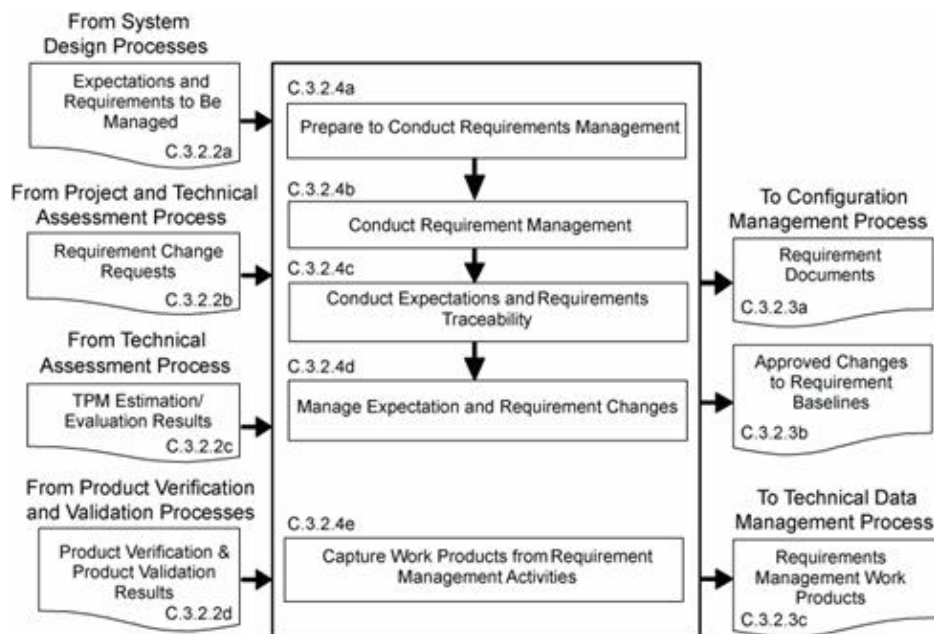


Figure C-10 - Technical Planning Process

## C.3.2 Requirements Management Process

### C.3.2.1 Purpose

#### C.3.2.2 Inputs and Sources:

- a. Expectations and requirements to be managed (from System Design Processes).
- b. Requirement change requests (the project and Technical Assessment Process).
- c. TPM estimation/evaluation results (from Technical Assessment Process)
- d. Product verification and product validation results (from Product Verification and Validation Processes)

### C.3.2.3 Outputs and Destinations:

- a. Requirement documents (to Configuration Management Process).
- b. Approved changes to requirement baselines (to Configuration Management Process).
- c. Requirements management work products needed to provide reports, records and non-deliverable outcomes of process activities (to Technical Data Management Process).

### C.3.2.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- a. Prepare to conduct requirements management to include:

- 1. Preparing or updating a strategy and procedures for:

- a) establishing that expectation and requirement statements, singularly and as a whole, are prepared in accordance with established formats and rules.

- b) identifying expectations and requirements to be managed, expectation and requirement sources, allocation and traceability of requirements, and linking product expectations and requirements with costs, weight, and power allocations as applicable

- c) formal initiation, assessment, review, approval and disposition of engineering change proposals and changes to expectation and requirements baseline.

- 2. Selecting or updating an appropriate requirements management tool.

- 3. Training technical team members in the established requirements management procedures and in the use of the selected/updated requirements management tool.

- b. Conduct requirements management to include: (1) capturing, storing and documenting the expectations and requirements; (2) establishing that expectation and requirement statements are compliant with format and other established rules; (3) confirming that each established requirements baseline has been validated; and (4) identifying and analyzing out-of-tolerance system-critical technical parameters and unacceptable validation and verification results and proposing requirement appropriate changes to correct out-of-tolerance requirements.

- c. Conduct expectation and requirements traceability to include: (1) tracking expectations and requirements between baselines, especially MOEs, MOPs, and TPMs, and (2) establishing and maintaining appropriate requirements compliance matrixes that contain the requirements, bidirectional traceability, compliance status, and any actions to complete compliance.

- d. Manage expectation and requirement changes to include: (1) reviewing engineering change proposals (ECPs) to determine any changes to established requirement baselines, (2) implementing formal change procedures for proposed and identified expectation or requirement changes, and (3) disseminating the approved change information.

- e. Capture work products from requirements management process activities to include maintaining and reporting information on the rationale for and disposition and implementation of change actions, current requirement compliance status, and expectation and requirement baselines.

### C.3.2.5 Process Flow Diagram

A typical process flow diagram for requirements management is provided in Figure C-11 with inputs and their sources and the outputs and their destinations. The activities of the requirements management process are truncated to indicate the action and object of the action.

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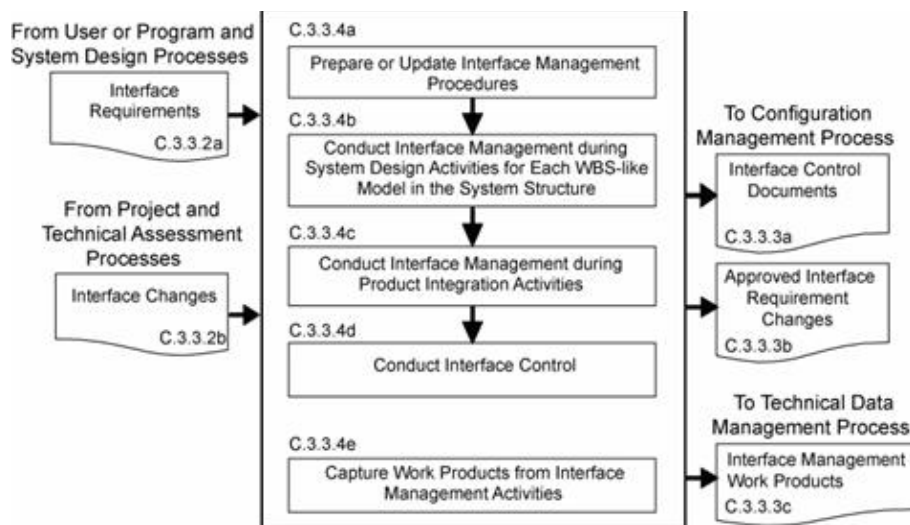


Figure C-11 - Requirements Management Process

### C.3.3 Interface Management Process

#### C.3.3.1 Purpose

#### C.3.3.2 Inputs and Sources:

- a. Internal and external functional and physical interface requirements for the products of a WBS model (from user or program and System Design Processes).
- b. Interface change requests (from project, and Technical Assessment Processes).

#### C.3.3.3 Outputs and Destinations:

- a. Interface Control Documents (to Configuration Management Processes).
- b. Approved interface requirement changes (to Configuration Management Process)
- c. Interface management work products needed to provide reports, records, and non-deliverable outcomes of process activities (to Technical Data Management Process)

#### C.3.3.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

a. Prepare or update interface management procedures for (1) establishing interface management responsibilities for those interfaces that are part of agreement boundaries, (2) maintaining and controlling identified internal and external physical and functional interfaces, (3) preparing and maintaining appropriate physical and functional interface specifications or interface control documents and drawings to describe and control interfaces external to the system end product, (4) identifying interfaces between system products (including humans) and among configuration management items, (5) establishing and implementing formal change procedures for interface evolution, (6) disseminating the needed interface information for integration into technical effort activities and for external interface control, and (7) training technical teams and other applicable support and management personnel in the established interface management procedures.

b. Conduct interface management during system design activities for each WBS model in the system structure to include: (1) integrating the interface management activities with requirements management activities; (2) analyzing the concept of operations to identify critical interfaces not included in the stakeholder set of expectations; (3) documenting interfaces both external and internal to each WBS model as the development of the system structure emerges and interfaces are added and existing interfaces are changed; (4) documenting origin, destination, stimulus, and special characteristics of interfaces; (5) maintaining the design solution definition for internal horizontal and vertical interfaces between WBS models in the system structure; (6) maintaining horizontal traceability of interface requirements across interfaces and capturing status in the established requirements compliance matrix; and (7) confirming that each interface control document or drawing that is established has been validated with parties on both sides of the interface.

c. Conduct interface management during product integration activities to include: (1) reviewing product integration

procedures to ensure that interfaces are marked to ensure easy and correct assembly/connection with other products, (2) identifying product integration planning to identify interface discrepancies, if any, and report to the proper technical team or technical manager, (3) confirming that a pre-check is completed on all physical interfaces before connecting products together, (4) evaluating assembled products for interface compatibility, (5) confirming that product verification and product validation plans/procedures include confirming internal and external interfaces, and (6) preparing an interface evaluation report upon completion of integration and product verification and product validation.

d. Conduct interface control to include: (1) managing interface changes within the system structure. (2) identifying and tracking proposed and directed changes to interface specifications and interface control documents and drawings. (3) confirming that the vertical and horizontal interface issues are analyzed and resolved when a change affects products on both sides of the interface. (4) controlling traceability of interface changes including source of the change, processing methods and approvals, and (5) disseminating the approved interface change information for integration into technical efforts at every level of the project.

e. Capture work products from interface management activities.

### C.3.3.5 Process Flow Diagram

A typical process flow diagram for interface management is provided in Figure C-12 with inputs and their sources and the outputs and their destinations. The activities of the interface management process are truncated to indicate the action and object of the action.

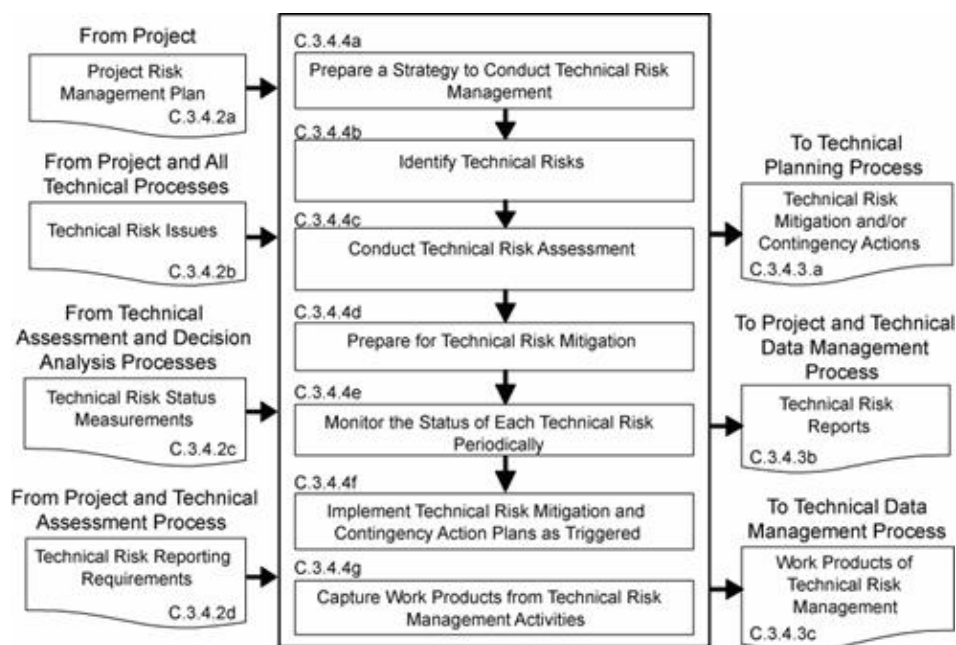


Figure C-12 - Interface Management Process

## C.3.4 Technical Risk Management Process

### C.3.4.1 Purpose

### C.3.4.2 Inputs and Sources:

- Project Risk Management Plan (from project)
- Technical risk issues (from project and other common technical processes).
- Technical risk status measurements (from Technical Assessment and Decision Analysis Processes).
- Technical risk reporting requirements (from project and Technical Planning Process).

### C.3.4.3 Outputs and Destinations:

- Technical risk mitigation and/or contingency actions (to Technical Planning Process for re-planning and/or re-direction).
- Technical risk reports (to project and Technical Data Management Process).

- c. Work products from technical risk management activities (to Technical Data Management Process).

#### C.3.4.4 Activities

For the WBS model in the system structure, the following activities are typically performed; (NPR 8000.4, Risk Management Procedural Requirements, is to be used as a source document for defining this process and implementing procedures.)

- a. Prepare a strategy to conduct technical risk management to include: (1) documenting how the project risk management plan will be implemented in the technical effort; (2) planning identification of technical risk sources and categories; (3) identification of potential technical risks; (4) characterizing and prioritizing technical risks; (5) planning informed technical management (mitigation) actions should the risk event occur; (6) tracking technical risk status against established trigger; (7) resolving technical risk by taking planned action if established trigger is tripped; and (8) communicating technical risk status and mitigation actions taken, when appropriate.

b. Identify technical risks to include: (1) identifying sources of risk issues related to the technical effort; (2) anticipate what can go wrong in each of the source areas to create technical risk issues; (3) analyzing identified technical risks for cause and importance; (4) preparing clear, understandable, and standard form risk statements; and (5) coordinating with relevant stakeholders associated with each identified technical risk.

c. Conduct technical risk assessment to include: (1) categorizing the severity of consequences for each identified technical risk in terms of performance, cost, and schedule impacts to the technical effort and project; (2) analyze the likelihood and uncertainties of events associated with each technical risk and quantify (for example by probabilities) or qualify (for example by high, moderate, or low) the probability of occurrence in accordance with project risk management plan rules; and (3) prioritize risks for mitigation.

d. Prepare for technical risk mitigation to include: (1) selecting risks for risk mitigation and monitoring, (2) selecting an appropriate risk handling approach, (3) establishing the risk level or threshold when risk occurrence becomes unacceptable and triggers execution of a risk mitigation action plan, (4) selecting contingency actions and triggers should risk mitigation not work to prevent a problem occurrence, (5) preparing risk mitigation and contingency action plans with identification of responsibilities and authorities.

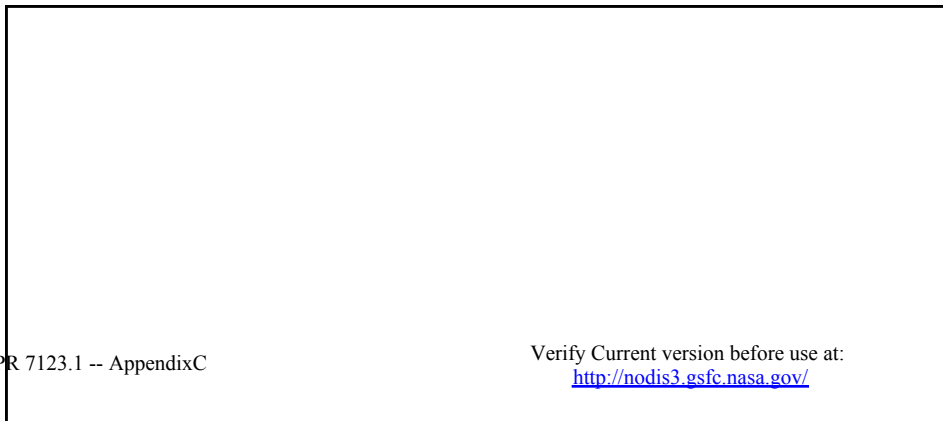
e. Monitor the status of each technical risk periodically to include: (1) tracking risk status to determine whether conditions or situations have changed so that a risk monitoring is no longer needed or new risks have been discovered, (2) comparing risk status and risk thresholds, (3) reporting risk status to decision authorities when a threshold has been triggered and an action plan implemented, (4) preparing technical risk status reports as required by the project risk management plan, (5) communicating risk status during technical reviews in the form specified by the project risk management plan.

f. Implement technical risk mitigation and contingency action plans when the applicable thresholds have been triggered to include: (1) monitoring the results of the action plan implemented, (2) modifying the action plan as appropriate to the results of the actions, (3) continuing actions until the residual risk and/or consequences impacts are acceptable or become a problem to be solved, (4) communicate to the project when risks are beyond the scope of the technical effort to control, will affect a product higher in the system structure, or represent a significant threat to the technical effort or project success, (5) preparing action plan effectiveness reports as required by the project risk management plan, (6) communicating action plan effectiveness during technical reviews in the form specified by the project risk management plan.

g. Capture work products from technical risk management activities.

#### C.3.4.5 Process Flow Diagram

A typical process flow diagram for technical risk management is provided in Figure C-13 with inputs and their sources and the outputs and their destinations. The activities of the technical risk management process are truncated to indicate the action and object of the action.



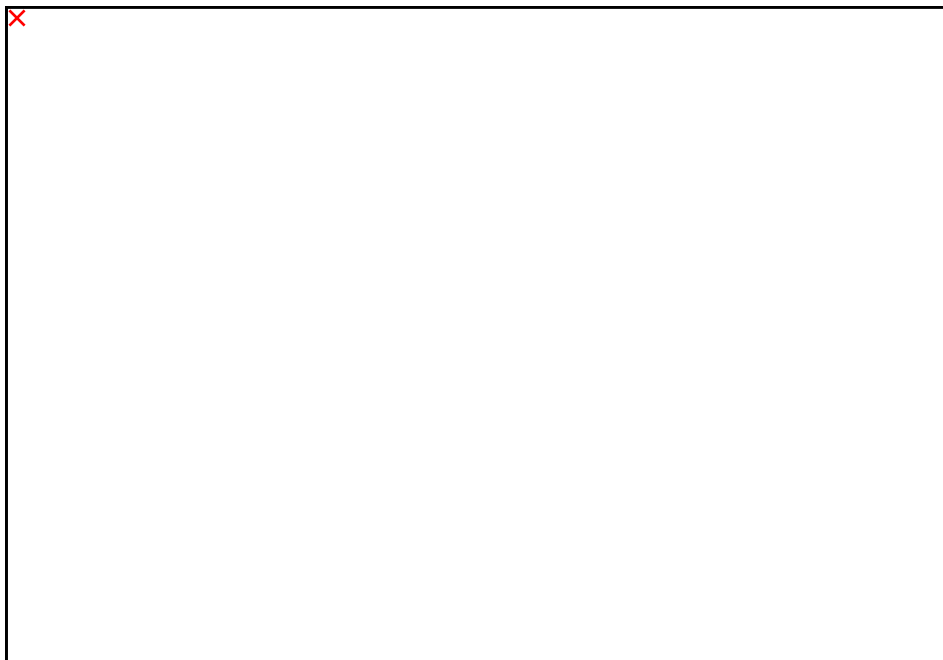


Figure C-13 - Technical Risk Management Process

### C.3.5 Configuration Management Process

#### C.3.5.1 Purpose

#### C.3.5.2 Inputs and Sources:

- a. Project configuration management plan, if any (from project).
- b. ECPs (from contractors, if any, and technical teams).
- c. Expectations and requirement outputs to include stakeholder expectations, technical requirements, derived technical requirements, system and end product specifications, requirement documents, and interface control documents/drawings (from Requirements and Interface Management Processes).
- d. Approved requirement baseline changes, including interface requirement changes (from Requirements Management and Interface Management Processes).
- e. Concepts of operations, enabling product strategies, logical decomposition models, SEMP, technical plans, and other configuration items identified in the list of CIs to be controlled (from Stakeholder Expectation Definition, Logical Decomposition, Technical Planning, and other technical processes as appropriate).

#### C.3.5.3 Outputs and Destinations:

- a. List of configuration items to be placed under control (to applicable technical processes).
- b. [Current baselines \(to Technical Requirements Definition, Logical Decomposition, Design Solution Definition, and Product Implementation, Integration, Verification, and Validation Processes.\)](#)
- c. Configuration management reports (to project and Technical Data Management Process).
- d. Work products from configuration management activities (to Technical Data Management Process).

#### C.3.5.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- a. Prepare a strategy to conduct configuration management for the system products and designated work products to include: (1) documenting how the project configuration management plan, if any, will be implemented; (2) identifying configuration items to be put under configuration control; (3) identifying schema of identifiers to accurately describe a configuration item and its revisions or versions; (4) controlling changes to configuration items; (5) maintaining and reporting disposition and implementation of change actions to appropriate stakeholders including technical teams within the project; (6) ensuring that products are in compliance with specifications and configuration

documentation during reviews and audits; (7) providing the appropriate reference configuration at the start of each product-line life-cycle phase; (8) obtaining appropriate tools for configuration management; and (9) training appropriate technical team members and other technical support and management personnel in the established configuration management strategy and any configuration management procedures and tools.

b. Identify baselines to be under configuration control to include: (1) listing of the configuration items to control; (2) providing each configuration item with a unique identifier; (3) identifying acceptance requirements for each baseline identified for control; (4) identifying the owner of each configuration item; and (5) establishing a baseline configuration for each configuration item.

c. Manage configuration change control to include: (1) establishing change criteria, procedures, and responsibilities; (2) receive, record, and evaluate change requests; (3) tracking change requests to closure; (4) obtaining appropriate approvals before implementing a change; (5) incorporating approved changes in appropriate configuration items; (6) releasing changed configuration items for use; and (7) monitoring implementation to determine whether changes resulted in unintended effects (e.g., have not compromised safety or security of baseline product).

d. Maintain the status of configuration documentation to include: (1) maintaining configuration item description records and records that verify readiness of configuration items for testing, delivery, or other related technical efforts; (2) maintaining change requests, disposition action taken, and history of change status; (3) maintaining differences between successive baselines; and (4) controlling access to and release of configuration baselines.

e. Conduct configuration audits to include: (1) auditing baselines under control to confirm that the actual work product configuration matches the documented configuration, the configuration is in conformance with product requirements, and records of all change actions are complete and up to date; (2) identifying risks to the technical effort based on incorrect documentation, implementation, or tracking of changes; (3) assessing the integrity of the baselines; (4) confirming the completeness and correctness of the content of configuration items with applicable requirements; (5) confirming compliance of configuration items with applicable configuration management standards and procedures; and (6) tracking action items to correct anomalies from audit to closure.

f. Capture work products from configuration management activities to include a list of identified configuration items; description of configuration items placed under control; change requests and disposition of the request and rationale for the disposition; documented changes with reason for change and change action; archive of old baselines; and required reports on configuration management outcomes.

### C.3.5.5 Process Flow Diagram

A typical process flow diagram for configuration management is provided in Figure C-14 with inputs and their sources and the outputs and their destinations. The activities of the configuration management process are truncated to indicate the action and object of the action.

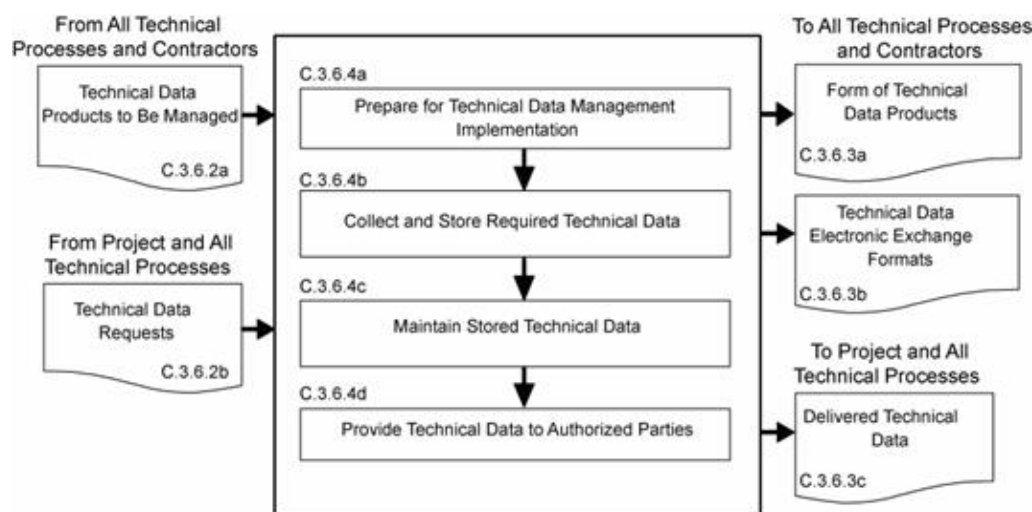


Figure C-14 - Configuration Management Process

## C.3.6 Technical Data Management Process

### C.3.6.1 Purpose

### C.3.6.2 Inputs and Sources:

a. Technical data and work products to be managed (from all technical processes and contractors).



b.Requests for technical data (from all technical processes and project).

### **C.3.6.3 Outputs and Destinations:**

- a. Form of technical data products (to all technical processes and contractors).
- b.Technical data electronic exchange formats (to all technical processes and contractors).
- c. Delivered technical data (to project and all technical processes).

### **C.3.6.4 Activities**

For the WBS model in the system structure, the following activities are typically performed:

a. Prepare a strategy for the conduct of technical data management to include: (1) determining required data content and form and electronic data exchange interfaces in accordance with international standards or agreements; (2) establishing a framework for technical data flow within the project technical processes and to/from contractors; (3) designating technical data management responsibilities and authorities regarding origination, generation, capture, archiving, security, privacy and disposal of technical data work products; (4) establishing the rights, obligations, and commitments regarding the retention of, transmission of, and access to technical data items; (5) establishing relevant data storage, transformation, transmission, and presentation standards and conventions to be used, project or program policy, and agreements or legislative constraints; (6) describing the methods, tools, and metrics used during the technical effort and for technical data management; and (7) training appropriate technical team members and support and management personnel in the established technical data management strategy and related procedures and tools.

b. Collect and store required technical data to include: (1) identifying existing sources of technical data that are designated as outputs of the common technical processes; (2) collecting and storing technical data in accordance with the technical data management strategy and procedures; (3) recording and distributing lessons learned; (4) performing technical data integrity checks on collected data to confirm compliance with content and format requirements and identifying errors in specifying or recording data; and (5) prioritizing, reviewing, and updating technical data collection and storage procedures.

c. Maintain stored technical data to include: (1) managing the databases to maintain proper quality and integrity of the collected and stored technical data and to confirm that the technical data is secure and is available to those with authority to have access; (2) performing technical data maintenance as required; (3) preventing the stored data from being used or accessed inappropriately; (4) maintaining the stored technical data in a manner that protects it against foreseeable hazards such as fire, flood, earthquake, and riots; and (5) maintaining periodic back-ups of each technical database.

d. Provide technical data to authorized parties to include: (1) maintaining an information library or reference index to provide data available and access instructions; (2) receiving and evaluating requests for technical data and delivery instructions; (3) confirming that required and requested technical data is appropriately distributed to satisfy the needs of the requesting party and in accordance with established procedures, directives, and agreements; (4) confirming that electronic access rules are followed before allowing access to the database and before any data is electronically released/transferred to the requester; and (5) provide proof of correctness, reliability, and security of technical data provided to internal and external recipients.

### **C.3.6.5 Process Flow Diagram**

A typical process flow diagram for technical data management is provided in Figure C-15 with inputs and their sources and the outputs and their destinations. The activities of the technical data management process are truncated to indicate the action and object of the action.

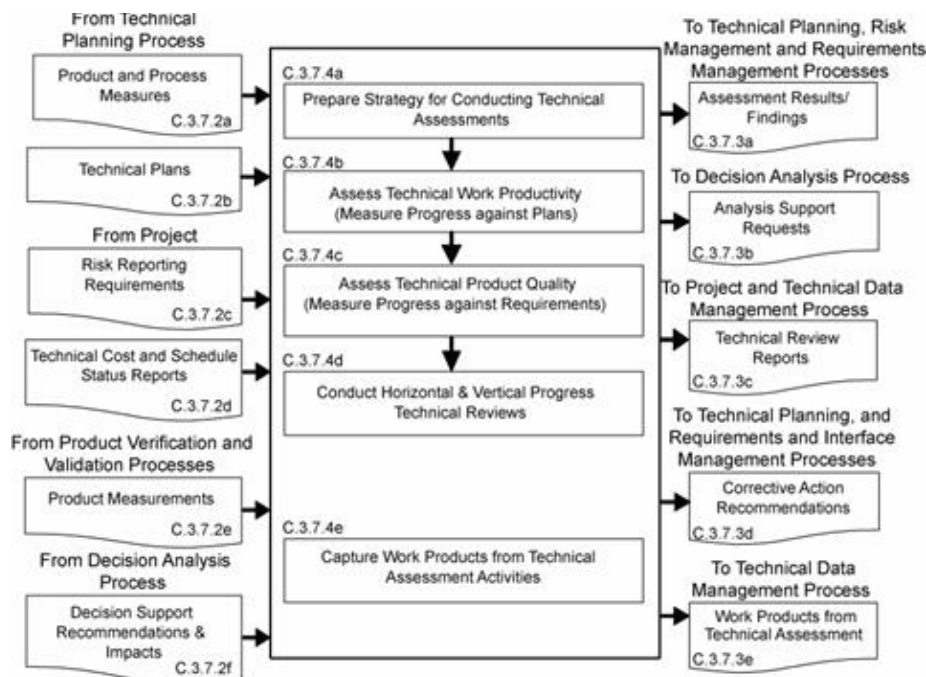


Figure C-15 - Technical Data Management Process

## C.3.7 Technical Assessment Process

### C.3.7.1 Purpose

### C.3.7.2 Inputs and Sources:

- Process and product measures (from Technical Planning Process).
- Technical plans including the SEMP (from Technical Planning Process).
- Risk reporting requirements during technical reviews (from project).
- Technical cost and schedule status reports (from project).
- Product measurements (from Product Verification and Product Validation Processes).
- Decision support recommendations and impacts (from Decision Analysis Process).

### C.3.7.3 Outputs and Destinations:

- Assessment results and findings including technical performance measurement estimates of measures (to Technical Planning, Technical Risk Management and Requirements Management Processes).
- Analysis support requests (to Decision Analysis Process).
- Technical review reports (to project and Technical Data Management Process).
- Corrective action and requirement change recommendations including corrective actions to correct out-of-tolerance TPMs (to Technical Planning, Requirements Management, and Interface Management Processes).
- Work products from technical assessment activities (to Technical Data Management Process).

### C.3.7.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- Prepare a strategy for conducting technical assessments to include: (1) identifying the plans against which progress and achievements of the technical effort are to be assessed; (2) establishing procedures for obtaining cost expenditures against work planned and task completions against schedule; (3) identifying and obtaining technical requirements against which product development progress and achievement will be assessed and establishing the procedures for conducting the assessments; (4) establishing events when TPMs, estimation or measurement

techniques, and rules for taking action when out-of-tolerance conditions exist will be assessed; (5) identifying and planning for phase-to-phase technical reviews and WBS model-to-model vertical progress reviews, as well as establishing review entry and success criteria, review board members, and close out procedures; (6) establishing which technical effort work products will undergo peer review, the team members who will perform the peer reviews, and reporting requirements; and (7) training team members, support staff, and managers involved in conducting technical assessment activities.

b. Assess technical work productivity (progress and achievement against plans) to include: (1) identifying, collecting, and analyzing process measures (e.g., earned value measurements for measuring progress against planned cost, schedule, resource use, and technical effort tasks) and identifying and reporting cost-effective changes to correct variances; (2) monitoring stakeholder involvement according to the SEMP; and (3) monitoring technical data management against plans.

c. Assess product quality (progress and achievements against technical requirements) to include: (1) identifying, collecting, and analyzing the degree of technical requirement and TPM satisfaction; (2) assessing the maturity of the WBS model products and services as applicable to the applicable product-line life-cycle phases; (3) determining any variances from expected values of product performance and identifying and defining cost-effective changes to correct variances.

d. Conduct technical reviews to include: (1) identifying the type of technical reviews and each review's purpose and objectives (see Chapter 5 for specific technical reviews that apply); (2) determining progress toward satisfying entry criteria; (3) establishing the makeup of the review team; (4) preparing the review presentation materials; and (5) identifying and resolving action items resulting from the review.

e. Capture work products from the conduct of technical assessment activities to include: (1) identifying variances resulting from technical assessments; (2) identifying and reporting changes to correct variances; (3) recording methods used in doing assessment activities; (4) documenting assumptions made in arriving at the process and product measure outcomes; and (5) reporting corrective action recommendations.

### C.3.7.5 Process Flow Diagram

A typical process flow diagram for technical assessment is provided in Figure C-16 with inputs and their sources and the outputs and their destinations. The activities of the technical assessment process are truncated to indicate the action and object of the action.

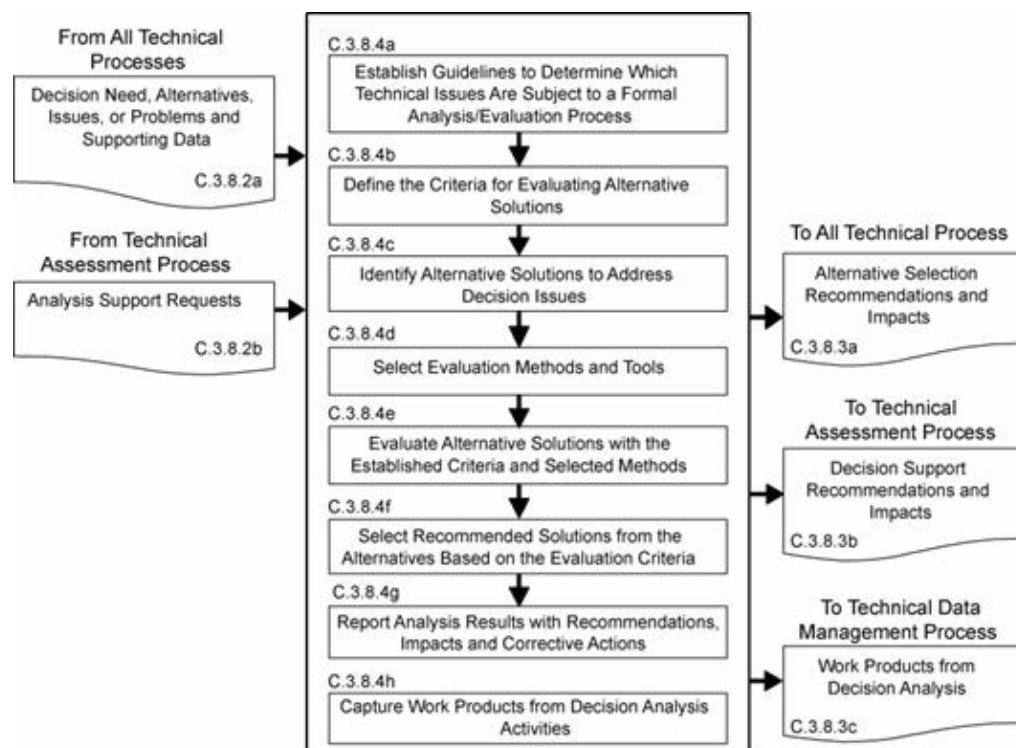


Figure C-16 - Technical Assessment Process

## C.3.8 Decision Analysis Process

### C.3.8.1 Purpose

### C.3.8.2 Inputs and Sources:

- a. Decision need, alternatives, issues, or problems and supporting data (from all Technical Processes).
- b. Analysis support requests (from Technical Assessment Process).

### C.3.8.3 Outputs and Destinations:

- a. Alternative selection recommendations and impacts (to all Technical Processes)
- b. Decision support recommendations and impacts (to Technical Assessment Process)
- c. Work products of decision analysis activities (to Technical Data Management Process).

### C.3.8.4 Activities

For the WBS model in the system structure, the following activities are typically performed:

- a. Establish guidelines to determine which technical issues are subject to a formal analysis/evaluation process to include: (1) when to use a formal decisionmaking procedure, for example, as a result of an effectiveness assessment, a technical trade off, a problem needing to be solved, action needed as a response to risk exceeding the acceptable threshold, verification or validation failure, make-buy choice, evaluating a solution alternative, or resolving a requirements conflict; (2) what needs to be documented; (3) who will be the decision makers and their responsibilities and decision authorities; (4) how decisions will be handled that do not require a formal evaluation procedure.
- b. Define the criteria for evaluating alternative solutions to include: (1) the types of criteria to consider including the following: technology limitations, environmental impact, safety, risks, total ownership and life-cycle costs, and schedule impact; (2) the acceptable range and scale of the criteria; and (3) the rank of each criterion by its importance.
- c. Identify alternative solutions to address decision issues to include alternatives for consideration in addition to those that may be provided with the issue.
- d. Select evaluation methods and tools/techniques based on the purpose for analyzing a decision and on the availability of the information used to support the method and/or tool.
- e. Evaluate alternative solutions with the established criteria and selected methods to include: (1) evaluation of assumptions related to evaluation criteria and of the evidence that supports the assumptions; and (2) evaluation of whether uncertainty in the values for alternative solutions affects the evaluation.
- f. Select recommended solutions from the alternatives based on the evaluation criteria to include documenting the information that justifies the recommendations and gives the impacts of taking the recommended course of action.
- g. Report the analysis/evaluation results/findings with recommendations, impacts, and corrective actions.
- h. Capture work products from decision analysis activities to include: (1) decision analysis guideline generated and strategy and procedures used; (2) analysis/ evaluation approach, criteria, and methods and tools used; (3) analysis/evaluation results, assumptions made in arriving at recommendations, uncertainties, and sensitivities of the recommended actions or corrective actions; and (4) lessons learned and recommendations for improving future decision analyses.

### C.3.8.5 Process Flow Diagram

A typical process flow diagram for technical decision analyses is provided in Figure C-17 with inputs and their sources and the outputs and their destinations. The activities of the decision analysis process are truncated to indicate the action and object of the action.

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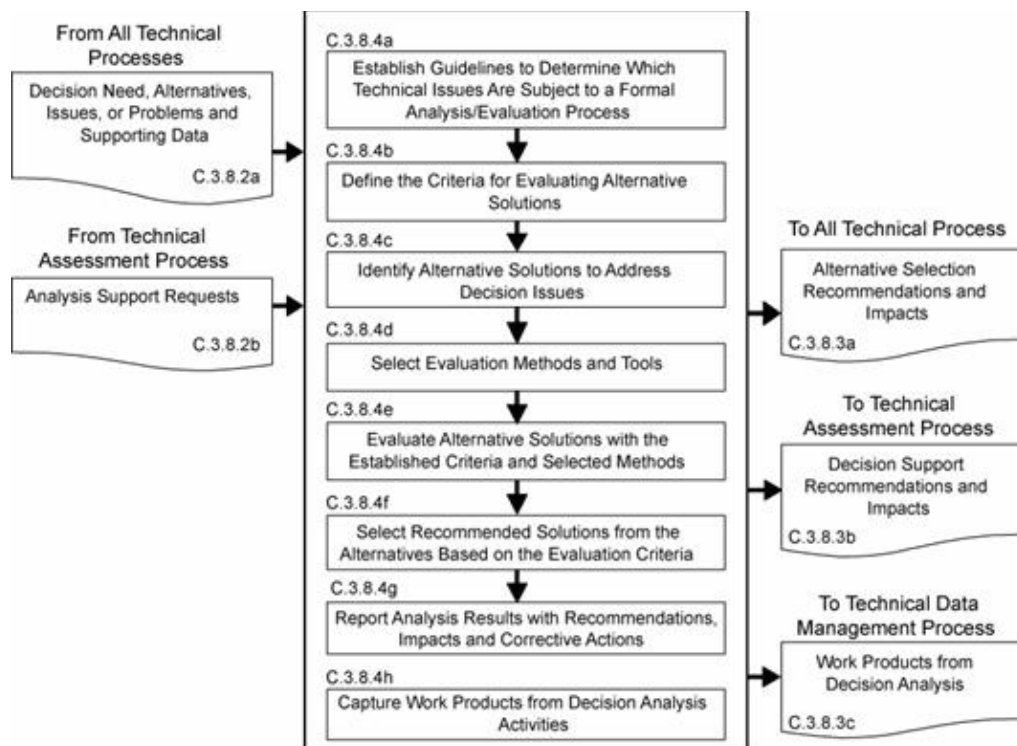


Figure C-17 - Decision Analysis Process

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